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(54) Title: BREATHING APPARATUS FOR RESPIRATORY PROTECTION			
(57) Abstract			
<p>Breathing apparatus to provide respiratory protection having an outer hood, an inner hood, a reservoir at positive pressure, a breathable gas source and a conveyance means with one way valves in an open circuit system.</p>			
<p>The diagram illustrates a breathing apparatus with various labeled parts: 1 (outer hood), 2 (inner hood), 3 (reservoir), 4 (breathable gas source), 5 (conveyance means), 6 (one way valve), 7 (outer hood opening), 8 (inner hood opening), 9 (reservoir opening), 10 (valve assembly), 11 (breathable gas source opening), 12 (conveyance means opening), 13 (breathable gas source tube), 14 (inner hood support), and 15 (valve assembly detail).</p>			

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BREATHING APPARATUS FOR RESPIRATORY PROTECTION

This invention relates to breathing apparatus for respiratory protection of civilians and combatants.

Early types of breathing apparatus include a flexible hood with a visor for aviators (F741127) and a rigid helmet with a glass window for divers (GB426962), both with a remote breathable gas supply. More recently, various types of portable breathing apparatus have been described. A simple transparent bag with a neck seal and a filter is known (GB 2129670A) but the design is defective due to a large effective dead space. The deficiency may be overcome by incorporation of an oro nasal mask (ONM) or other conveyance means in the breathing circuit. It is well known in the art to have such an ONM supported by a strap harness and to have inlet and outlet valves, both for a breathable gas system (WO82/02492) and for a filter system (EPO275934A2). However, problems may arise from a poorly fitting ONM which allows outward leakage of exhaled gas with effective increase of dead space. Also, moisture in the exhaled gas condenses on a visor, if fitted, to cause misting and impairment of vision. In the present invention a close fitting elasticated fabric helmet is used as a harness to exert even traction all round the rim of the ONM and pulls it onto the face to secure a good fit. The neck seal of the hood, which forms an integral part of the breathing apparatus, may be sealed by a draw string (WO82/02492, EPO275934A2) but much inward leakage of the noxious external atmosphere takes place past this type of seal. An elasticated septal neck seal (GB2129670A) allows less leakage but the leakage may be further reduced by having a positive pressure inside the hood. A positive pressure may be achieved by passing exhaled gas to the hood space (GB2211098A, GB2164570A) but such designs are defective because the moisture in the exhaled gas impairs vision. Positive pressure breathing apparatus is well known (GB 1587121, GB 2074456A). In the present invention, unlike GB 1587121, a reservoir is described between two hoods and it differs from GB 2074456A in that complex pressure reducing valves are not required. In the present invention a positive pressure is achieved by passing dry gas under pressure and at constant flow directly into the hood space reservoir. There is virtually no inward leakage past the neck seal if the hood space remains at positive pressure and this is ensured if the volume of the reservoir is in excess of the breathing volume of the wearer and if the inlet and outlet valves are set at appropriate opening pressures. In the present invention inward leakage past the ONM is not important and outward leakage from ONM to hood space is minimised by improved goodness of fit. There is therefore no significant increase in effective dead space and misting is prevented by ingress of dry gas from the breathable gas source. Thus, the present invention discloses breathing apparatus having a reservoir, in the hood space between inner and outer hoods, filled with dry breathable gas to prevent misting and under positive pressure to prevent inward leakage; having the inner hood elasticated to support the conveyance means, to pull it onto the face and to secure a good fit, and having an open circuit

with one way valves to ensure that there is high performance with very low dead space and high efficiency. The present invention is filed with a co-pending application which describes a retaining harness means.

According to the present invention there is described by way of example only breathing apparatus to provide respiratory protection and having an outer hood, an inner hood, a reservoir at positive pressure, a breathable gas source and a conveyance means with one way valves in an open circuit system such that:

A) the outer hood is:

- (i) made from impermeable gas proof material,
- (ii) transparent at least in part,
- (iii) completed by an elastic neck seal;

B) the inner hood is:

- (i) close fitting to the head,
- (ii) made from elasticated material,
- (iii) attached to the outer hood,
- (iv) attached to the rim of the conveyance means to support it and pull the rim onto the face;

C) the reservoir is:

- (i) positioned in the space between the inner and outer hoods,
- (ii) constructed with a volume which is in excess of the breathing volume of the user;

D) the breathable gas source discharges dry breathable gas directly into the reservoir to raise it to positive pressure and

E) the conveyance means covers the mouth and nose of the user and has:

- (i) a one way inlet valve which allows breathable gas to pass from the reservoir to the cavity of the conveyance means and
- (ii) a one way outlet valve which allows breathable gas to pass from the conveyance means cavity to the ambient atmosphere.

The functions of the component parts of the apparatus, in relation to the atmosphere, are as follows.

- (1) The outer protective hood is impervious to gas and resistant to flame to protect the head and respiratory tract of the wearer.
- (2) The neck seal is made of elasticated material which fits round the neck and, together with the outer hood, completes the gas impermeable enclosure.
- (3) The central opening of the neck seal is stretched to pass over the head when donning the hood and fits closely to the neck when donned.
- (4) The conveyance means covers the nose and mouth.
- (5) The cavity of the conveyance means is the space within it.
- (6) The rim of the conveyance means seals against the face of the wearer.
- (7) The inner hood is elasticated and tightly fitting to the head. It is attached to the rim of the conveyance means, exerts even traction and pulls it onto the face to achieve a good seal.
- (8) The reservoir is the space between the outer and inner hood. It has a volume which is greater than the breathing volume of the wearer and it contains breathable gas.
- (9) The inlet valve allows gas to pass in only one direction from the reservoir to the cavity of the conveyance means.
- (10) The outlet valve allows gas to pass in only one direction from the conveyance means cavity to the ambient atmosphere.
- (11) The breathable gas source is a cylinder which contains the breathable gas under pressure.
- (12) The manual switch is used to switch on and off the supply of breathable gas from the source.
- (13) The inner and outer hoods are joined together at the circumference on the inner side of the outer hood.
- (14) The opening of the inner hood is positioned at the front to permit vision and to make orientation obvious on donning.
- (15) The external ambient atmosphere is outside the hood and may contain smoke particles and noxious gases.

FIGURE

A specific embodiment and the functioning thereof is now described by way of example only with reference to the accompanying schematic drawing in which figure 1 shows the breathing apparatus as worn by a subject and having the component parts numbered as above.

The breathing apparatus is donned by stretching the opening 3 of the neck seal 2 and pulling the outer hood 1 over the head. This is attached 13 to the inner hood 7 which is therefore also pulled onto the head. The closely fitting inner hood 7 is also attached to the rim 6 of the conveyance means or mask 4 which is correctly positioned by the act of donning the hood 7 with the opening 14 at the front. The breathable gas source 11 is activated manually by the switch 12 and fills the reservoir 8 with breathable gas under pressure. On inspiration, breathable gas is sucked in through the inlet valve 9 and the cavity 5 of the mask 4 to the lungs. On expiration, exhaled gas passes through the cavity 5 of the mask 4 and the outlet valve 10 to the external ambient atmosphere 15. Positive pressure in the reservoir 8 is maintained by an appropriate setting for the opening pressure of one or other or both of the valves 9 and 10.

It is obvious to those skilled in the art that the outer hood may be fire proof; the entire outer hood or only a part of it may be transparent; a draw string may be fitted round the neck; the conveyance means may be a mouth piece, oro nasal mask, full face mask or other device; the inner hood may be elasticated in more than one dimension; the inner hood attachment to the conveyance means rim may be direct or indirect and may be complete or incomplete; the conveyance means rim may be shaped to the face and nose; the breathable gas may be air, oxygen or mixed gas, compressed or chemically generated; a reducing valve may be required between the compressed gas cylinder and the reservoir; a relief valve may be required to prevent over pressurization of the reservoir; release of gas may be activated manually, automatically or on demand; there may be two eye openings with a central part or cord to prevent deformation of the opening or openings; there may be a plurality of inlet and outlet valves; the inner hood may support and carry the breathable gas source and container; an external or remote gas source may be added; the system may be adapted for closed or semiclosed circuit use; a carbon dioxide absorber and rebreathing reservoir may be added and a filter or anti suffocation device may be added for use when the breathable gas source is exhausted. It is also obvious that the breathing apparatus has many applications in civilian use including escape from fire and smoke and toxic fumes in sewers, laboratories and chemical factories and in military use against war gases and other agents.

CLAIMS

- 1) Breathing apparatus to provide respiratory protection having an outer hood, an inner hood, a reservoir at positive pressure, a breathable gas source and a conveyance means with one way valves in an open circuit system such that:
 - A) the outer hood is:
 - (i) made from impermeable gas proof material,
 - (ii) transparent at least in part,
 - (iii) completed by an elastic neck seal;
 - B) the inner hood is:
 - (i) close fitting to the head,
 - (ii) made from elasticated material,
 - (iii) attached to the outer hood,
 - (iv) attached to the rim of the conveyance means to support it and pull the rim onto the face;
 - C) the reservoir is:
 - (i) positioned in the space between the inner and outer hoods,
 - (ii) constructed with a volume which is in excess of the breathing volume of the user;
 - D) the breathable gas source discharges dry breathable gas directly into the reservoir to raise it to positive pressure and
 - E) the conveyance means covers the mouth and nose of the user and has:
 - (i) a one way inlet valve which allows breathable gas to pass from the reservoir to the cavity of the conveyance means, and
 - (ii) a one way outlet valve which allows breathable gas to pass from the conveyance means cavity to the ambient atmosphere.
- 2) Breathing apparatus according to claim 1 in which the breathable gas source is compressed air.
- 3) Breathing apparatus according to claim 1 or 2 in which the opening pressures of the inlet and outlet valves are set to maintain a positive pressure in the reservoir.
- 4) Breathing apparatus according to any preceding claim in which a demand valve is provided.
- 5) Breathing apparatus substantially as herein described according to the drawing.

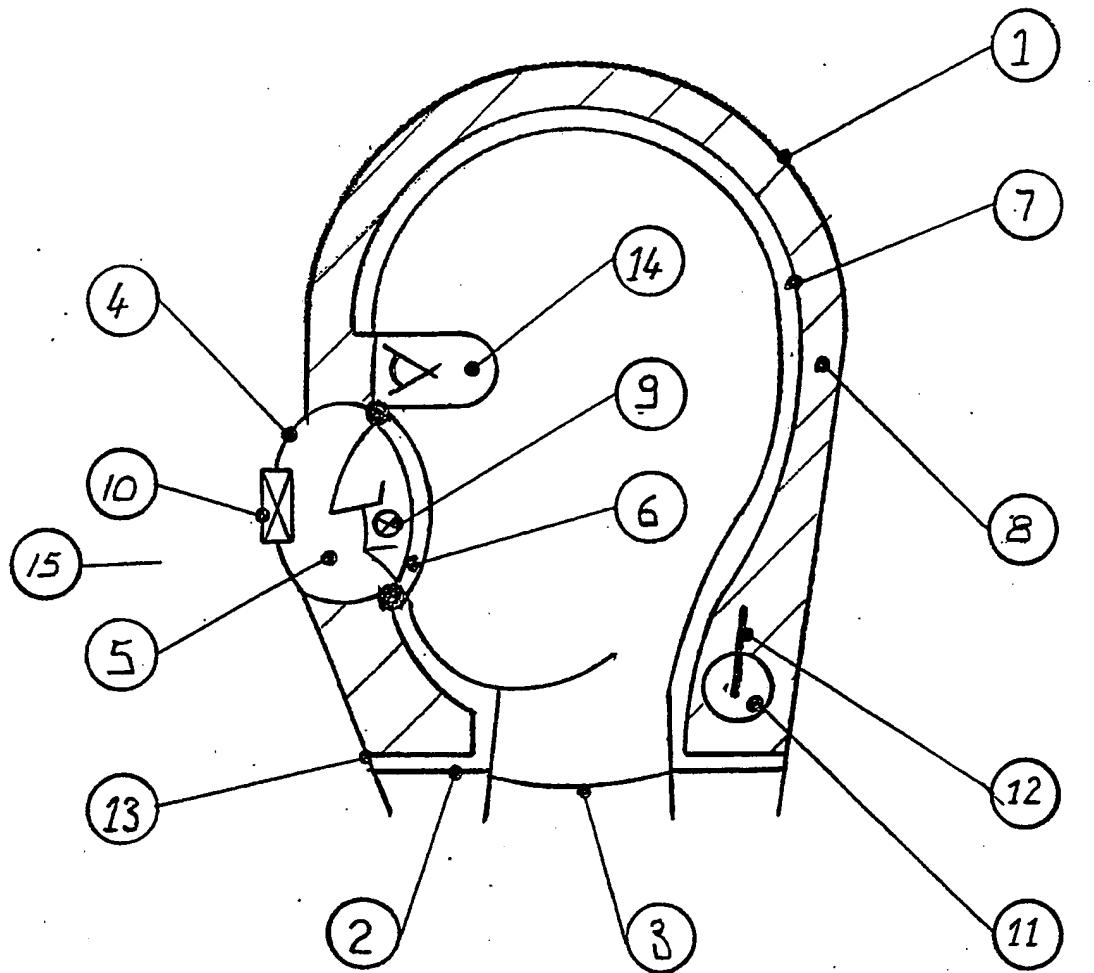


FIGURE 1

INTERNATIONAL SEARCH REPORT

International Application No

GB 92/01656

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A62B17/04

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System	Classification Symbols
Int.Cl. 5	A62B ; B63C

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	EP,A,0 301 732 (THE BRITISH PETROLEUM COMPANY PLC) 1 February 1989 see column 5, line 2 - line 48; figure 1 ---	1
A	EP,A,0 197 641 (E.I.DU PONT DE NEMOURS & CO) 15 October 1986 see page 4, line 27 - page 5, line 7; figure 1 ---	1
A	FR,A,2 646 781 (Y. LE MASSON) 16 November 1990 see page 3, line 7 - page 4, line 3; figure ---	1
A	GB,A,2 074 456 (DRÄGERWERK AG) 4 November 1981 cited in the application -----	1

¹⁰ Special categories of cited documents :¹⁰

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IV. CERTIFICATION

Date of the Actual Completion of the International Search

07 DECEMBER 1992

Date of Mailing of this International Search Report

23.12.92

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

TRIANTAPHILLOU P.



ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. GB 9201656
SA 65092

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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		GB-A-	2207338	01-02-89
		JP-A-	1043271	15-02-89
EP-A-0197641	15-10-86	CA-A-	1276857	27-11-90
		JP-A-	61206465	12-09-86
FR-A-2646781	16-11-90	None		
GB-A-2074456	04-11-81	DE-A-	3015584	29-10-81
		FR-A, B	2481121	30-10-81
		SE-B-	439588	24-06-85
		SE-A-	8100507	24-10-81
		US-A-	4403608	13-09-83